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THE USE OF GLUE MOLDS IN REPRODUCING ABORIGINAL MONUMENTS AT QUIRIGUA, GUATEMALA

By NEIL M. JUDD

IN January, 1910, the School of American Archæology commenced a series of investigations at the ruins near Quirigua, Guatemala. These investigations have been continued every year, with one exception, since that date, and during the operations of the winter of 1913–14, the most recent of the series, the author was a chance associate, having in charge that phase of the work which these notes consider.

The expedition of 1914 entered the field with two distinct motives: (1) a continuation of former excavations[1] on the structures surrounding the Temple Court, and (2) the reproduction in plaster of as many of the stone stelæ, for which Quirigua is so justly famous, as time and local conditions would permit. We shall concern ourselves, in the following pages, solely with the casting of the monuments.

Readers familiar with the history of Quirigua will recall that the ruins remained unknown to the scientific world until John L. Stephens published an account of his travels through Central America in 1839 and 1840; also that very little additional information was obtained until an English traveler, Mr A. P. Maudslay, made known the results of his observations at the old city during 1881–1883 and 1894. In addition to the usual notes, measurements, and photographs, Mr Maudslay obtained, on his last two visits, a number of paper squeezes and plaster piece-molds[2] of the great monuments in the Ceremonial Court or Plaza. These molds were taken to England and plaster casts made from them.

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[1] See *Bulletin of the Archæological Institute of America*, vol. II, pp. 117–134 (1911), and vol. III, pp. 163–171 (1912); also *National Geographic Magazine*, vol. XXIV, pp. 339–361.

[2] A "paper squeeze" is the resultant negative impression when several superimposed layers of well-soaked paper are pounded into the superficial irregularities of an object and allowed to dry in place. A plaster "piece-mold" is a collection of individually-shaped plaster blocks that unite to form a complete mold.

Similar molds of the sculptured stones at this and other prehistoric Central American sites were obtained by subsequent expeditions, among which those of the Peabody Museum at Cambridge are most noteworthy. None of the paper squeezes obtained by these early expeditions, however, produced casts that are entirely satisfactory. Existing reproductions give a general impression of the original, to be sure, and are therefore highly desirable for museum exhibition, but their value for the study of the hieroglyphics has been lessened by the unavoidable inaccuracy and indistinctness with which they represent the carved inscriptions on the monuments. Such casts, the author believes, ought to serve both as museum examples of primitive American sculpture and as exact facsimiles for laboratory study of the ancient Mayan system of hieroglyphics.

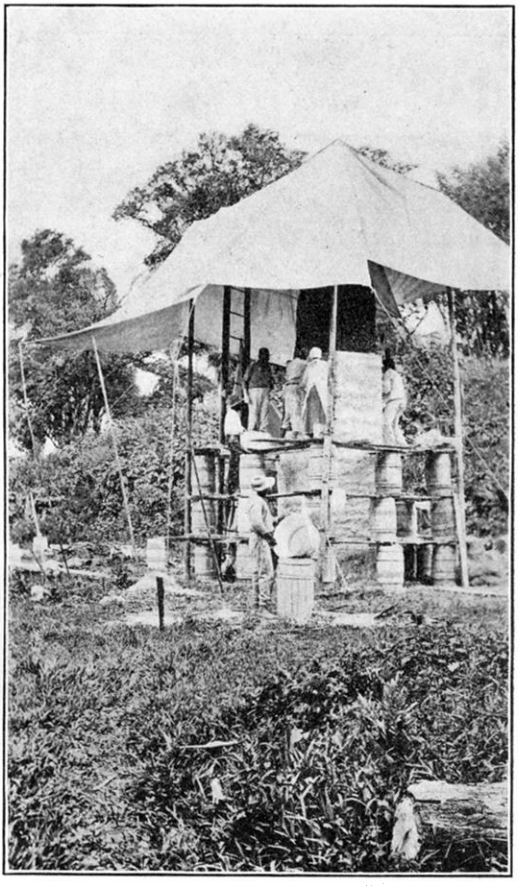


FIG. 29.—Constructing the plaster forms around one of the stelæ.

The preservation of exact copies of Mayan monuments, and especially of their carvings, is quite necessary, for the action of the elements is slowly but surely erasing this evidence of primitive man's cultural development in the jungles of Guatemala. When

Maudslay made his first observations, these stones were almost hidden in the dense forest and were overgrown with a thick mat of vines and moss in which even large trees had taken root. He removed this growth in order to secure better photographs, but after his visit a new covering had formed, and the cleaning was necessarily repeated when the School of American Archæology began its investigations several years ago. When our party reached Quirigua last January, we found that a slight growth of lichens had reappeared on all the stelæ, but it readily yielded to a scrubbing brush.

These Quirigua monuments are of two types: tall stones with human figures carved on both faces and columns of hieroglyphics on the narrower sides, and low, animal-shaped blocks bearing similar inscriptions on their backs and sides. Each monument has been carved from a solid block of stone, of a texture that multiplies the difficulties of successful reproduction. The rock may be described as scoriaceous sandstone, for it consists mostly of volcanic scoria, with varying proportions of sand and coarse gravel. Earthquakes

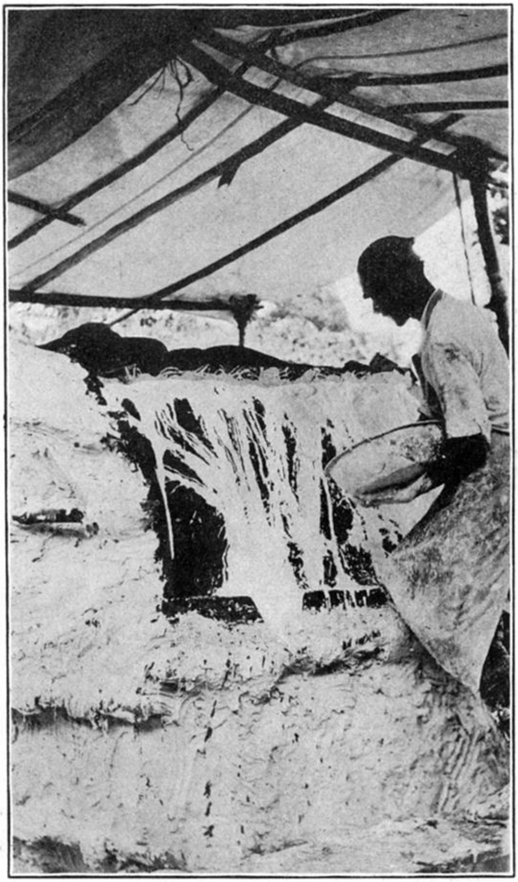
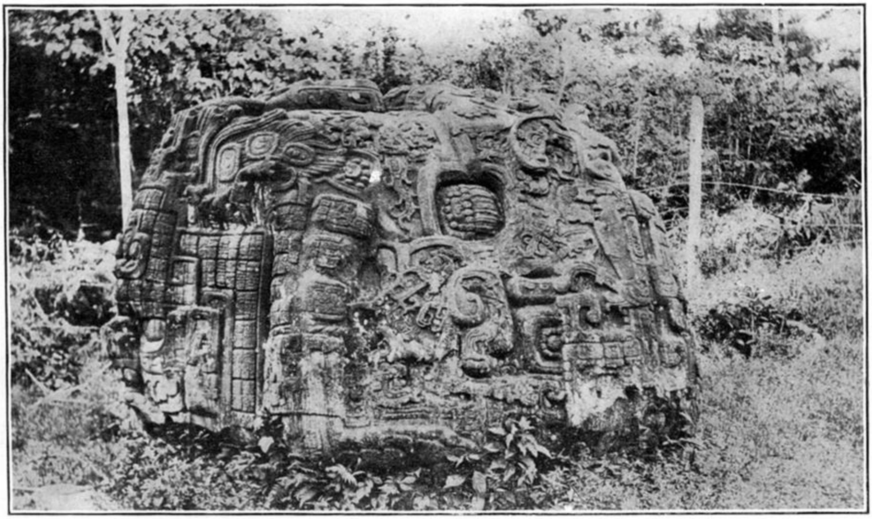
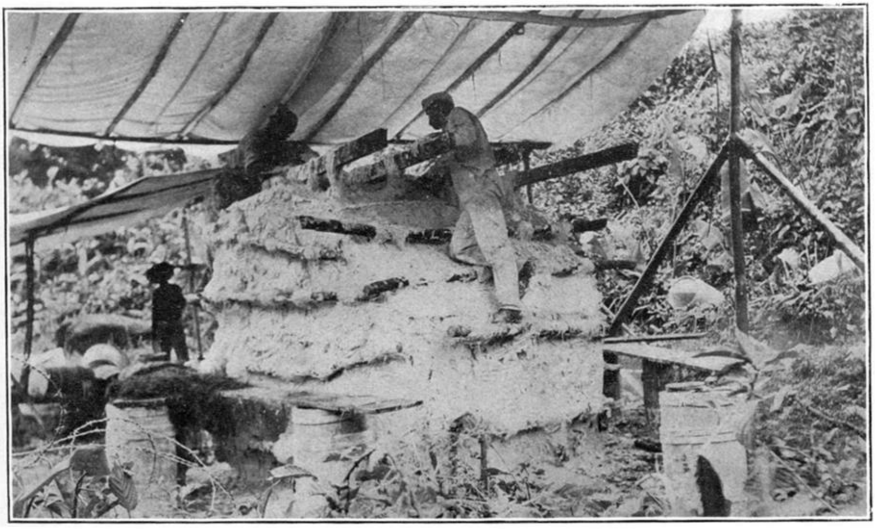


FIG. 30.—Each form was made with liquid plaster, over a layer of clay mud.



1. THE "GREAT TURTLE"

Maudslay's plaster piece-mold of this monument required more than 600 pieces and about three months for completion; with glue molds, a finished cast in eleven parts was produced in fifteen days



2. COMPLETING THE PLASTER FORMS OVER THE "GREAT TURTLE"

and growing vegetation have broken and split these heavy masses, as well as the remaining walls of the temples; swaying branches and dripping water have cut and grooved their surfaces and liberated many exposed pebbles, thereby adding small pittings to the already rough, granular faces. Such a superficial texture greatly increases the difficulties of making satisfactory paper molds by resisting every effort to force pulp or similar lifeless materials into the pores of the stone's surface, and by tenaciously gripping those substances, once they have been driven into place. In reproducing the irregular texture of the Quirigua monuments, glue proved an ideal agent, since the material of the molds was applied in a liquid condition, and, when hardened, its natural elasticity permitted great distortion in removal. It was easily manipulated when properly prepared, yet gave considerable difficulty before its tropical limitations were sufficiently determined.

Glue, or gelatin, is an animal substance that deteriorates rapidly on exposure to heat and moisture. Commercially, gelatin is obtained in thin, dry flakes that require soaking and melting in preparation for use. Although well known and much utilized in decorative architectural construction in the cooler portions of the country, glue had never before been employed in the American tropics. Those experts whom we had consulted seriously doubted its practicability for such a task as ours—they were a unit in advising adherence to the old methods, despite admitted imperfections.

During our first weeks in Guatemala, while awaiting the arrival of supplies, we performed such minor experiments as available materials would permit. It became evident at this time that glue molds must be prepared with more care in the tropics than in the workshops of our New England states. For instance, a mere dampening of the dry flakes gave firmer, heavier molds that yielded more satisfactory casts than those made from glue which had received the customary soaking. Our first pourings were too thin and resulted in soft, rather sticky molds incapable of producing clear-cut reproductions. We learned also that melted glue, left in pails or tubs, would neither cool nor solidify, but deteriorated within a comparatively short time. After having served their purpose, our glue molds were usually cut into small pieces and remelted. When all these fragments were not required for the evening pouring, they were dried and retained for future use, but if carelessly spread and a free circulation of air prevented, the pieces invariably sweated and soured, rendering them unfit for new molds. With all its uncertainties, however, glue proved an ideal medium for the hasty reproduction of such enormous, irregular carvings as those at Quirigua.

Our method of mold-making was very simple. We began by building a light plaster foundation around the base of the monument, to prevent the escape of the melted glue and to support the weight of the plaster forms which were to surround the monument and serve as retaining walls for the glue molds. Above this foundation, a definite section of the stone was covered with a layer of common clay mud, approximately one inch thick. In building the forms, such large quantities of this mud were used that one native was kept at work continually, mixing with his bare feet, while one or two companions kneaded it into sizable balls. These masses were then pounded or thrown onto the stone

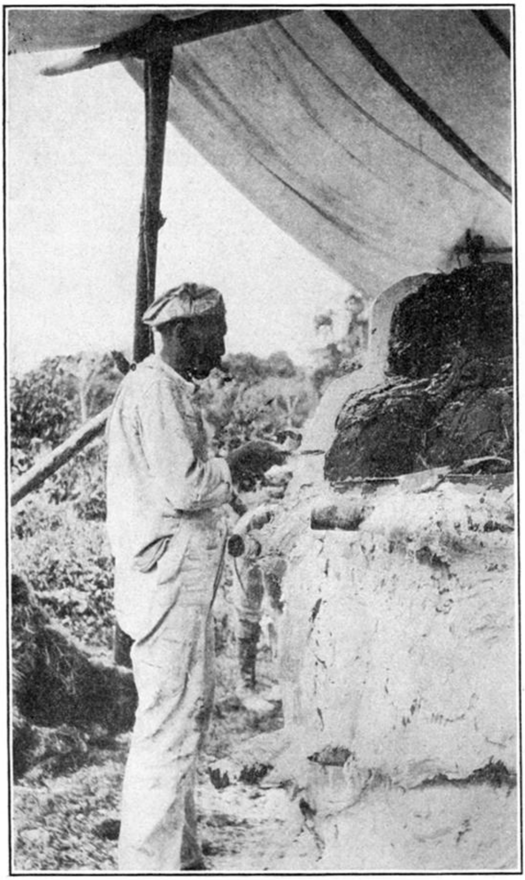


FIG. 31.—The edges of each form were carefully trimmed before an adjoining form was begun.

with force sufficient to make them adhere, uniform thickness of the layer and its conformation with the outline of the stone being preserved during the operation.

Over this clay were built the forms or supports above referred to. While being constructed, each form was braced with two or more small saplings, laid at right angles upon a number of bamboo strips. Each form was completed and its edges carefully trimmed before the adjoining form was begun. Four of these forms, one for each side of the monument, composed a section. On completion, the several parts were bound together with temporary ties of plaster-soaked fiber and the working platforms raised for another series. Continuing in this manner, the whole monument was covered—a layer of clay, of a thickness corresponding to that of the desired mold, lying against the stone, and over this clay the carefully-matched plaster forms. When the topmost form had been finished, the real process of mold-making began.

Commencing at the top, one entire horizontal section was lowered each day and the subjacent layer of clay thrown aside. The exposed surface of the stone was then thoroughly scrubbed to remove what dirt and lichenous growth still clung to the monument. The inside surfaces of the four forms were scraped free from all irregularities and painted with a coat of thick clay-water which filled the pores of the plaster and aided materially in separating molds and forms. After the stone had dried, it was oiled with a composition of stearine, kerosine, and vaseline, and the forms raised to their original position, bound with fiber, and all joints covered with plaster. In their "original position" these forms were separated from the monument by an interstice equal to the thickness of the layer of clay over which they had been built. Into this space the melted glue was later poured. The resultant glue molds, therefore, were equal in thickness to the layer of clay they replaced; their backs were supported by the plaster forms, and their faces reproduced, in intaglio, the lines and carvings of the monument.

During these preparations, galvanized iron tubs, containing glue, were over the fires and their contents melting for the daily pouring. To avoid burning the material, that tub which held the glue was placed upon three or four small stones in a larger receptacle and separated from it by a quantity of boiling water. The outer vessel, in turn, rested upon iron rods or pointed stones that raised it above the fire-pit. When the glue had thoroughly melted and attained uniform consistency, it was ready for the forms.

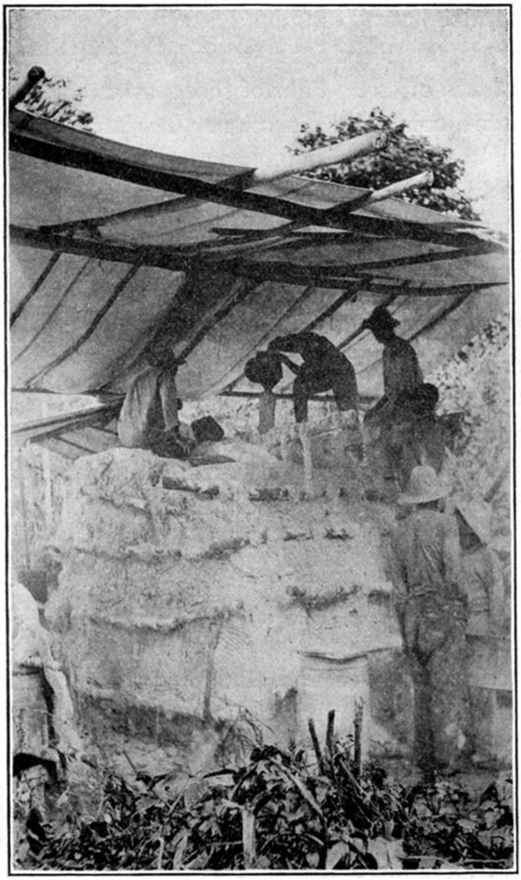
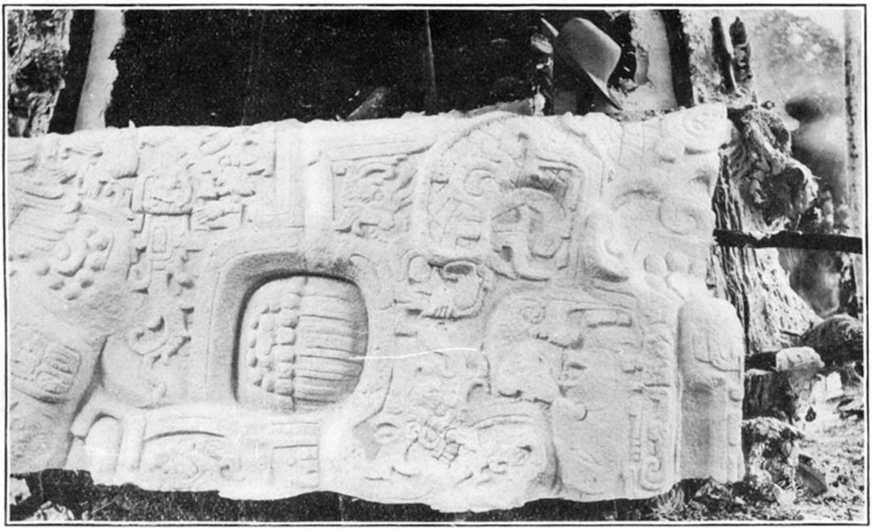
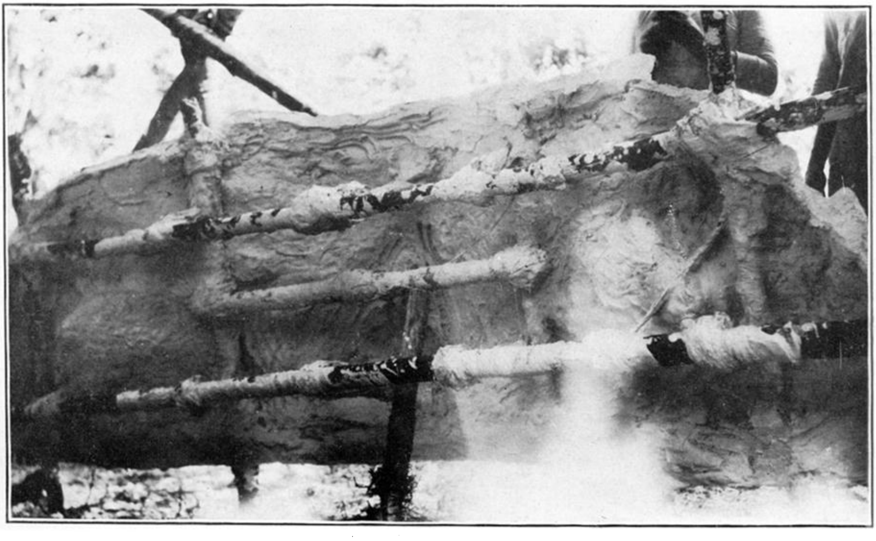


FIG. 32.—Pouring one of the upper molds on the "Great Turtle."

Pouring the glue was a simple process, and required only a number of pails and men to pass them. Our day's work was so divided that this operation was performed just before sundown, leaving the cool hours of the night for the hardening of the molds. Small holes for the escape of air bubbles were drilled through those forms that inclined from the perpendicular, but they were always reclosed as the melted glue, rising in the mold-space, began to flow from them. Further to prevent the formation of bubbles in the glue after it had been poured into the forms, improvised funnels were frequently employed, the pressure of the liquid remaining in the funnel after the forms had been filled forcing out the imprisoned air and also counteracting the effect of shrinkage along the upper edges of the molds.



1. PLASTER CAST FROM UPPER EASTERN SIDE OF THE "GREAT TURTLE"



2. THE BACK OF EACH CAST WAS REENFORCED WITH SAPLINGS AND ROPES OF PLASTER-SOAKED FIBER

The plaster forms had been built one against the other, therefore their joints were as tight and fitted as nicely as two reunited fragments of a broken dish. In order that the plaster casts might unite perfectly, the glue molds from which they were taken, conformed, necessarily, to the dimensions of their forms. The shrinkage of the solidifying glue left a narrow, unrecorded margin along the upper edge of each section of molds, an inaccuracy that was easily overcome by adding a low rim of plaster to the top of each series of forms. When filled with glue, these enlarged forms produced molds that were slightly wider than those desired, but the excess was easily removed with a knife, leaving the glue molds flush with the original edges of their forms and assuring perfect joints when the sections should be finally united.

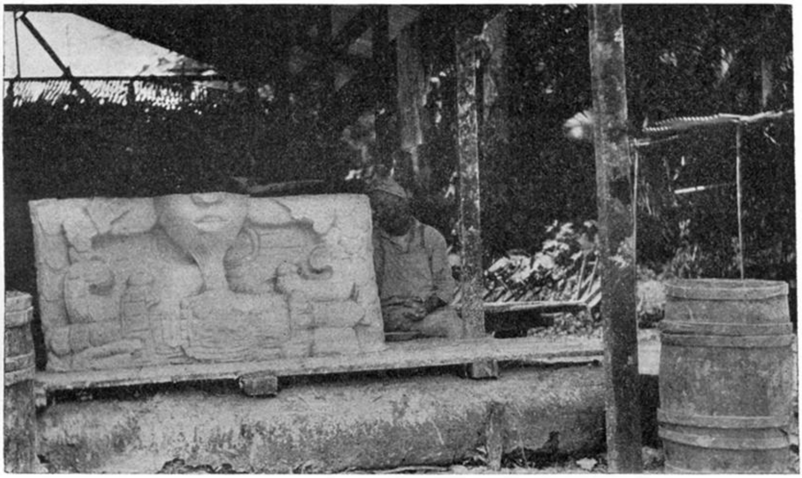


FIG. 33.—Retouching a section of the cast of a tall monument.

Each morning at daylight the glue molds poured the previous evening were lowered from the monument and prepared for casting. Great care was taken to protect these molds from even the early-morning sun, since only a few moments' exposure served to soften and melt the impression. The molds, supported by their respective plaster forms, were first dusted with French chalk, to remove any adhering grease, then thoroughly brushed with a saturated alum solution. This liquid required, on an average, about one hour for complete evaporation, but it always left a thin coating of alum that hardened the surface of the glue molds and aided materially in protecting them from the heat generated by the setting of the plaster composing the casts. The mold surfaces were lightly oiled with stearine and kerosine before applying the plaster.

The casts were made by covering the oiled surface of each glue mold with liquid plaster, the thickness of which varied in direct proportion to the size and irregularity of the mold. Wooden braces and hemp fiber, imbedded in the plaster, increased the toughness of the casts and lessened the possibility of their warping and breaking.

Each horizontal section of the stelæ, or upright monuments, consisted of four casts which were usually united before being separated from the glue molds. Since the plaster forms were made in close conformation with the outline of the monument, their corner angles were known to be exact. By matching these corners and uniting the four parts of the newly-made plaster cast while they still rested against the glue molds and their supporting plaster forms, the angles of the cast could be made as perfect as those of the stone whose inscriptions it reproduced. Any other method would have required numerous measurements and much care in using them. Our way merely necessitated uniform setting of the plaster composing the detached parts of the cast and a reasonable amount of speed in joining them, for, even with an alum-hardened surface, the heat of the setting plaster soon melted the glue molds.

The climate was, of course, the greatest handicap under which the expedition labored. We reached Quirigua at the beginning of the dry season, a ninety-day period during which the rains are more irregular and of shorter duration than usual. Available 1914 records for this interval, February, March, and April, show an average daily temperature, as observed on the shaded veranda at the nearest United Fruit Company farmhouse, of 66° at 6 A.M.; 88° at noon; and 76° at 6 P.M. In the small, open space where our work of reproduction was pursued, the heat was obviously higher and more unbearable. Under the intense rays of the sun, not only the nature of our medium but also our personal comfort required a temporary shelter over the monument being cast. To afford this necessary protection, canvas tarpaulins were drawn over poles that reached above the monument, drop curtains being utilized when driving rain-storms or the afternoon sun threatened the exposed portions of the stone.

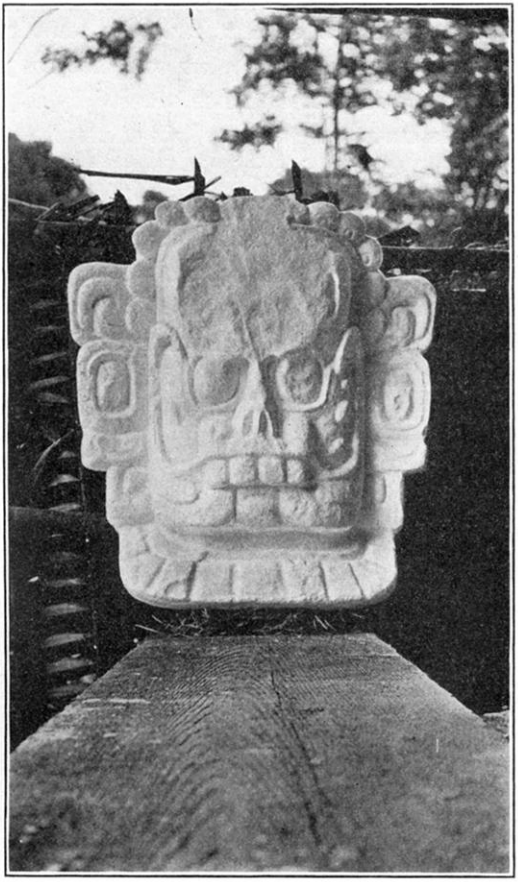


FIG. 34.—Plaster cast of a "Death's Head" from one of the stelæ.

Inability to secure cool water for casting increased the difficulties of that important branch of the work, made the setting of the plaster both irregular and uncertain, and required more haste in handling the materials than would otherwise have been necessary. A second vexing problem was encountered in the drying shed where minute worms developed a habit of exploring the interior of our plaster casts. Their prodigious appetities seemed insatiable, and the partial destruction of our season's work was avoided only by frequently exposing each cast to the direct rays of the burning sun.

For shipment, the casts were enclosed in wooden crates and protected with dried banana leaves. The fact that they survived the shock of repeated loadings and unloadings and reached their destination with very little breakage was due to generous and careful reënforcement rather than abundant packing.

The recent expedition entered the field with no previous experience and but very little knowledge of the use of glue molds. It employed a medium that had been considered impracticable in the torrid zone, but which, at comparatively small cost, has given results far surpassing those secured by any other process. In four months casts were made of six colossal monuments, and each cast, on close examination, will be found to be an exact counterpart of its original, reproducing not only every carved line and figure of the ancient sculpture but the very texture of the stone in which the carving was done. These reproductions are to be installed at San Diego, California, during the Panama-California Exposition, and later will be removed to the halls of the School of American Archæology at Santa Fe, New Mexico.

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